plein air. These latter are, at the end of this time, all as fresh and healthily green as they were at the moment of cutting off the parent plant, notwithstanding the very hot weather we have recently experienced. It seems to me that this is a clear proof that the *rôle* of leaves is to *absorb* as well as *evaporate*, a point on which much doubt has often been expressed. G. Paul.

Harrogate, September 29.

It has been proved over and over again, and it is easy to prove, that the leaves of some plants, though probably not of all, are capable, under certain conditions—usually abnormal conditions—of absorbing aqueous vapour or fluid water; but this action can hardly be regarded as a function, though I am not prepared to say that absorption of moisture by leaves is in no case a part of the every-day life of a plant. The return to turgidity of the leaves of a plant during the night is, however, in a general way, due, doubtless, to reduced transpiration, rather than absorption from the atmosphere. Yet in the absence of a counteracting current of water from the roots, the leaves of some plants, especially of those inhabiting almost rainless regions, but where the air sometimes reaches almost complete saturation, absorb moisture. At least, so it is asserted. With regard to absorption by detached leaves, or by leaves of detached branches, the development of the action depends, apart from other circumstances, on the amount of vital energy left; and this is determined, to a great extent, by age. The common Privet is a shrub of extraordinary vitality, rare in our native vegetation. I hardly need add that proof of leaves being able to absorb water may be had by inserting withered leaves in water by their upper halves, leaving the stalk out. If not too old, or too much dried, the whole leaves will regain turgidity, though the process may be a slow one.

W. Botting Hemsley.

Tertiary Fossil Ants in the Isle of Wight.

In a paper published in Nature for August 22, p. 399, by Prof. C. Emery, on "The Origin of European and North American Ants," the author states that "the Sicilian amber of Miocene age contains genera which belong to the actual Indian and Australian fauna, while the Baltic amber contains the genera Formica, Lasius, and Myrmica." In the Bembridge limestone in the Isle of Wight, of Eocene age, the same as the Baltic amber, the following genera occur: Formica, Myrmica, and Camponotus, and some others not yet described. In my collection there are a large number of these Hymenoptera, generally well preserved, and seem to be more numerous than any of the other insects from the same beds. It is only of late years that any number of insects have been met with in the British tertiaries, and it is well to record the two genera referred to Formica and Myrmica, being found both in the Baltic amber and Bembridge limestone. Among the numerous fossil insects in my possession from the Lias, no trace of any ants has been observed, and it seems that they did not come into existence until the later Tertiary epoch. P. B. Brodie.

THE NORMAL SCHOOL AT PARIS.

In connection with the celebrations of the centenary of the foundation of the École Normale in Paris, referred to at the time in these columns (vol. li. p. 613), a ponderous tome has been published[1] containing the complete history of the school, and details concerning the most renowned of its alumni. Opportunity is thus afforded of giving a sketch of the development of a school which has played an important part in the history of education for nearly a century, and which has been the training college of many of the most distinguished Professors in France.

The most elaborate article in the volume is a detailed history, by M. Paul Dupuy, on "L'École Normale de l'an III." That article has furnished the particulars with reference to the early history of the school given in this contribution.

When the Convention of the 9th Brumaire, An. III. (October 30, 1794), passed the decree to which the Normal School owes its foundation, it realised an idea which had occupied the attention of the University and Parliament for many years. So far back as 1645 the University of Paris considered a proposal by the rector, Dumonstier, to provide the means for the education of teachers and principals. After the expulsion of the Jesuits in 1761, the Parliament of Paris began to carry out the idea by instituting fellowships and uniting at Louis-le-Grand the scholars of the small colleges of the University. At the time when Parliament was taking these steps, Barletti de Saint-Paul was forming a training school for teachers, in which his principles of personal pedagogy were taught; and Bernardin de Saint-Pierre pleaded for a college of instruction. "J'admire avec étonnement," he wrote in 1789, "que tous les arts ont parmi nous leur apprentissage, excepté le plus difficile de tous, celui de former les hommes." To the influence which these educational reformers had in bringing the matter before the Government of the Revolution must be added the impulse derived from Germany, through Alsace. Alsace was then the only province of France able to furnish ideas and models for popular instruction. It had been touched by the great pedagogic movement in Germany, and its great influence upon the three Revolutionary Assemblies makes it prominent in the history of the Normal School.

Practically every part of the educational system of France owes its development to the Republic. The Committee of Public Welfare early concerned itself with the question of national education, and Commissions were appointed to report upon the best means for developing an educational system. In 1793 a plan was put forward to establish normal schools for the training of teachers. Nothing definite was formulated, however, with reference to the Normal School until September 1794, when the Committee of Public Instruction adopted a series of articles, the first of which was to the effect that "there should be established, at Paris, a Normal School, where instruction in the art of teaching science should be given to persons already possessing scientific knowledge." At the end of the following month, the National Convention, after a discussion of the scheme and the subjects to be taught, passed a law for the establishment of Écoles normales. The idea was to establish these schools in various parts of France, but it was not then realised, and the Normal School at Paris is the only one that owes its existence directly to the law of the Convention. Referring to the designation of the schools, an official note reads: "The word *normal*, which has been applied to the schools newly decreed, is taken from geometry. It expresses really the perpendicular or level. In the sense employed in this case it announces that all knowledge belonging to science, to the arts, to belles-lettres, &c., will there be taught, and taught to all equally." Science was thus placed upon the same footing as the humanities. The methods and results of investigation were not to be known to a few, but were to be taught by the most eminent men it was possible to obtain. The first programme of the courses and professors shows the scope of the instruction given.

Subjects.	Professors.
Mathematics	Lagrange and Laplace.
Physics	Haüy.
Descriptive Geometry	Monge.
Natural History	Daubenton.
Chemistry	Berthollet.
Agriculture	Thouin.
Geography	Buache and Mentelle.
History	Volney.
Morals	Bernardin de St. Pierre.
Grammar	Sicard.
Analysis of the Understanding	Garat.
Literature	La Harpe.

A glance at this list will show that the professors were selected on account of their eminence in different branches of knowledge rather than for purely pedagogic ability, though the object for which the school was founded was to instruct teachers in the principles of their profession. Berthollet was the only one of the professors of science who paid any serious attention to that subject in the official programme issued to the students; his colleagues confined themselves to purely scientific matters. Methods of research appear to have formed the subjects of the lectures rather than methods of exposition and education; Lagrange and Laplace made this plain in the following announcement of their courses: "To present the most important discoveries that have been made in the domain of science, to develop the principles underlying them; to notice the acute and valuable ideas which gave birth to them; to indicate the most direct road to discovery, and the best sources where details can be obtained; to show what is still to be done, and the steps it is necessary to take; these are the objects of the Normal School, and it is from this point of view that mathematics will be taught."

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[1] "Le Centenaire de l'École Normale." (Paris: Hachette et Cie.)

On January 21, 1795, the lectures commenced at the Museum d'histoire naturelle, the amphitheatre of which had just been completed, and which was given up provisionally to the Normal School. In the presence of a large assembly, Lakanal read the decree establishing the school, and was followed by Laplace, Haüy, and Monge, each of whom read their programmes, and indicated the lines they intended to follow. But the excited state of France during this period was such that the students could not be properly disciplined. Political petitions and manifestos frequently emanated from the school, and there appears to have been an almost entire want of organisation. The excessive petulance of the students showed itself during the lectures, and especially in debates after the lectures, the subjects of which were freely discussed and criticised, to the frequent embarrassment of the professors. Eventually the debates were suppressed in the case of the science lectures. Haüy substituted the debates by laboratory work, and the professors of mathematics instituted debating societies to be managed entirely by the students, who were to mutually assist one another. These conferences were only organised for mathematics, and they appear to have been installed at the College de France, where they were held every day. The "conference" system of education is a legacy from the Normal School of the year III. of the National Convention; to that school is also largely due the place which science now occupies in the French system of education; letters and science were taught by men of equal high rank and authority, and the students selected either branch of knowledge, according to their inclinations and natural gifts. The students at the school were drawn from all parts of France, and maintained by the Republic. But the national exchequer at the time could not stand any extra drain upon its impoverished resources. It is, therefore, no matter of surprise that when the courses ended in May 1795, the school was closed.

In spite of its imperfections, the School of the Convention exerted great and beneficial influence upon the French nation. Biot, in his history of science during the French Revolution, compares the school to a "vast luminous column which rose so high from the middle of a desolate land that its great brilliancy covered France and enlightened the future." And, speaking at the Paris Academy of Sciences in 1833, Arago said, with reference to the school, "It was always necessary to go back to the École normale to find the first public instruction in descriptive geometry. From that school the instruction passed, almost without modifications, to the École polytechnique. From the École normale also dates a veritable revolution in the study of pure mathematics. The demonstrations, methods, and important theories hidden in academic collections, were for the first time presented to students, and encouraged them to rebuild, on new bases, the works intended for education." Arago thus showed that, through the Normal School, science gained the right of an important place in public education. He insisted upon another point none the less important, viz. that at the Normal School, for the first time, at least officially, public education was given by the first men of intellect in the country. "With some rare exceptions, scientific investigators at one time formed in France a class totally distinct from that of the professors. By bringing the first geometers, the first physicists, the first naturalists into the professoriate, the Convention endowed the educational functions with unusual advantages, the fortunate results of which are still felt. In the eyes of the public, the school that bore the names of Lagrange, Laplace, Monge, and Berthollet could claim equality with the highest places of instruction." The first Normal School, in fact, in spite of its brief existence, founded a tradition which was preserved during the Restoration, and under the second Empire, and which has had a decisive influence upon the history of education in France. For this reason, M Dupuy is justified in concluding his detailed history of the School of the Convention with the words: "The centenary that the École normale has celebrated this year is therefore more than the centenary of its name; it is that of the institution itself under its first form."

The second stage in the history of the Normal School began in 1808 (that is, four years after Napoleon had changed France into an Empire), with an Imperial decree establishing "un pensionnat normal, destiné à recevoir jusqu'á trois cents jeunes gens qui y seront formés à l'art d'enseigner les lettres et les sciences." This decree extending the organisation of the French University, created two years before, founded definitely the present school. Before students were permitted to enter the school, they had to agree to remain in the teaching profession at least ten years. They attended classes at the Collège de France, the École polytechnique, and the Museum d'histoire naturelle, according to whether they intended to instruct in letters, or in different branches of science. An annual grant of three hundred thousand francs (£12,000) was voted for the expenses of the school. The regulations were based upon those of the colleges of the old university, so the students were prevented from taking part in the affairs of the political world. This organisation, however, did not last long; for in 1814 there came the entrance of France by the Allies, the abdication of Napoleon, and the tragic hundred days, all of which, with later events, had their effects upon the school. Louis XVIII. proposed to change the organisations of the school and university, and a decree with this end in view was passed in February 1815. But when Napoleon returned from Elbe, a few days later, he entirely suppressed the new regulations, and re-established the Imperial University in accordance with the decree of 1808. And when the Empire finally fell, the ministers of Louis XVIII. abandoned the idea of changing the organisation, and themselves supported the Imperial system. The school existed up to 1822 under these rules, when it was decided that its place should be taken by Écoles normales partielles. Four years later the school was re-established, but in order not to excite memories of the Revolution and the Empire, it was named the "École préparatoire." Only in the name did this school differ from the old Normal School, and even that was restored by Louis Phillippe, Duke of Orleans, who, in August 1830, shortly after he became King of the French, issued an order that "the school devoted to the education of professors, and for some years carried on under the name of École préparatoire, is to reassume the title of École normale." A little later, the school was organised on the lines upon which the studies are carried there to-day. The duration of the course of study, which in the École préparatoire had been two years, was definitely fixed at three years, and the sections of science and letters were more clearly separated than they had ever been before. After studying together during the first year, the science students, during the second and the third years, were arranged into two divisions, one of the physical and mathematical sciences, the other of natural sciences, the chemists being classified with the naturalists. In the second year the mathematicians and physicists had a few courses in common with the chemists and naturalists, but during the third year were kept altogether distinct.

The Government of Louis Philippe, which, in a way, established the fundamental system of primary instruction in France, gave the Normal School a firm standing by instituting competition and new classes ; it also took steps to provide proper accommodation for the students. The buildings of the Plessis, where the studies were conducted, were falling to pieces, and it was recognised that new ones would have to be provided. In 1838 the site in the rue d'Ulm, now occupied by the school, was chosen ; the plans were prepared, and money required to execute them was voted in the spring of 1841.

But six years passed before the work was done, and it was not until 1847 that the school was transferred to its new domicile, and the title of "École normal supérieure" was inscribed over the door. M. de Salvandy presided over the opening ceremony, and the director of studies, Dubois, who succeeded Cousin in 1840, read a summary of the history of the school. From that time until 1848, when Louis Napoleon became President of the French Republic, no change of importance occurred. The first event which, of the whole of the religious reactions favoured by the future Emperor of the French, foreshadowed rigorous changes in the school's regulations, was the substitution of M. Dubois by M. Michelle, rector of the Besançon Academy, in July 1850. The new director took the rank of inspector-general, and the school ceased to be represented upon the Council of the University. A year later, M. Vacherot, the director of studies, followed Dubois, and then M. Jules Simon, whose lectures were suspended at the end of 1851, resigned his connection with the school. The idea of suppressing the school altogether was afterwards seriously considered, but fortunately it was not carried into execution. Attempts were made to limit the freedom with which subjects were dealt, and, for a time, Protestants and Jews were refused admission. A better period commenced in 1857, when Nisard succeeded Michelle as the director of the school, and Pasteur became the director of scientific studies. Five science Fellowships were created in the following year, and the holders of them carried on researches under Henri Saint-Clair Deville and Pasteur, whose investigations increased the school's reputation.

After the affairs of 1870, which deposed Louis Napoleon and established the third Republic, Bersot was nominated director of the school by Jules Simon, and occupied that position until 1880. Under him, the constitution of the school was sustained, and brought back to what it was under the direction of Cousin and of Dubois. Bersot died in 1880, and the fifteen years that have elapsed since his death form the last period in the eventful history of the Normal School. M. Fustel de Coulanges was the director from 1880 to 1883, and since then the present director, M. Georges Perrot, has occupied that position. In 1880 a section of natural sciences was re-established, and this, with other improvements in the internal organisation, has assisted the school to the high place it now occupies.

The second part of the volume, from which many of the foregoing details were obtained, is taken up with biographies of the directors (each accompanied by a fine photogravure of the subject) and of papers referring to the men who have helped to develop the different departments of the school. Passing over the former section, we arrive at an account of the mathematical work at the school, by M. Jules Tannery. The high standing of this department may be judged by the fact that, of the six members of the Section of Geometry of the Paris Academy of Sciences, three belong to the Normal School. The Section of Astronomy contains two old students—one the present Director of the Paris Observatory. The school has contributed to this Academy the names of Pouillet, Delafosse, Pasteur, Jamin, V. Puiseux, P. Desains, Bouquet, Van Tieghem, Debray, Hébert, Tisserand, Fouqué, Wolf, Darboux, Troost, Mascart, Lippmann, Duclaux, Picard, Appel, and Perrier. M. Bertrand, the eminent Perpetual Secretary of the Academy, was one of the first among the illustrious men who have made the school what it is, and encouraged its students to scientific investigation. After him, Cauchy dominated mathematical education at the school. Hermite, Puiseux, Briot, and Bouquet were the close friends and disciples of this profound geometrician, who, during the early part of this century, gave mathematical science so great an impetus. Of these, only Hermite survives, and he celebrated his jubilee a few months ago. Among those who benefited by Hermite's instruction and counsel stand out the names of Baillaud, Charve, Floquet, and Pellet. Appel, Picard, and Goursat are among other students who have brought credit to their *alma mater.*

Verdet, whose electrical and optical researches are known to every physicist, became maître de conférences, that is, professor, of physics in 1848, and held that position until 1866. Mascart succeeded him for a few months, and was followed by Bertin-Mourot, who remained at the head of the physical department until 1884, since which year MM. Violle, Bouty, and Brillonin have filled the post.

Of all the teachers that the school has had, none have exercised greater influence upon it than Saint-Claire Deville. For thirty years he devoted his activities to the advancement of science at the school and to the welfare of his students. He succeeded Balard in 1851 as maître de conférences in the section of chemistry, and at once commenced to reorganise the work and develop research. His advice to students who looked to books to supply them with subjects of investigation, was: "Fermez bien vite tous les liveres, venez au laboratoire, passez-y toute la journée, faites-y n'importe quoi, reprenez par exemple minutilusement un travail classique ; vous êtes intelligent, vous ne tarderez pas à trouvez quelque résultat interressant." His numerous pupils profited by his invitation to work whenever possible in the laboratory, and many of them became his collaborators. Among these occur the names of Debray, Troost, Fouqué, Fernet, Lamy, Lechartier, Mascart, Isambert, Ditte, Joly, André, Angot, Dufet, Margottet, Chappuis, Parmentier, all of whom have advanced scientific instruction and research in France. Henri Deville never refused an investigator access to his laboratory, no matter what line of work was taken up, and the result was that not only chemists, but students of natural history, astronomy, and even an alchemist, availed themselves of the opportunity. After devoting the activities of a lifetime to science, Henri Deville died in July 1881, and by his death France lost one of its brightest lights.

Debray held a Fellowship at the Normal School when Henri Deville became the maître de conférences, and the two great investigators worked side by side for thirty years. He entered the school in 1847, and succeeded his master as professor at the Sorbonne and as maître de conférences at the school in 1875. He died in June 1888. Chemistry is at present under the charge of MM. Gernez and Joly.

The department of natural science in the school was established in 1880. The school had not existed until then, however, without paying any attention to the study of that division of scientific knowledge. M. Delafosse was maître de conférences of zoology, botany, geology, and mineralogy so far back as 1827, and among the naturalists who taught one or other of the subjects before the new section was created were Hébert, Lory, Fouqué, Van Tieghem, Dastre, Perrier, Cornu, Giard, Le Monnier, and Bonnier. The feature of the instruction now given is the large attention paid to field work. Frequent geological, botanical and zoological excursions are made under the charge of the professors, both during the school year and the holidays. At the marine biological stations, holiday courses are always offered. Owing to the labours of Prof. de Lacaze-Duthiers, biological laboratories have been established at various points on the French coast. Since 1881, many students of the Normal School have worked at the stations at Roscoff, Banyuls, Concarneau, Wimereux, and Saint-Waast, and the knowledge they have thus gained from nature herself is far in advance of that received through lectures or from books.

Pasteur's connection with the school has a melancholy interest at the present time. Before he left the Faculty of Sciences at Lille, to become administrator and director of studies, he had made his important researches on the tartrates of soda and ammonia, and had commenced the study of fermentation. He therefore wanted a laboratory in which to continue his researches, but the school could not at the time offer him one. After a little difficulty, one small room, about ten feet square, was obtained, and in that restricted space he made some of his most valuable discoveries. This accommodation however, was gradually increased. In 1862 a large room was expressly constructed for Pasteur's work, and was added to from time to time as the value of the researches carried on came to be recognised. Finally, it was impossible for him to carry on his extensive researches under the hospitable roof in the rue d'Ulm, and he had to remove to a larger building. A few years later his work for science and humanity was recognised by the construction, at a cost of more than £100,000, raised by international subscription, of the Pasteur Institute in Paris, where the results of his researches are daily applied, and where the remains of the great investigator will finally rest.

The valuable *Annales d'École Normale* owe their commencement to M. Pasteur. The journal was first issued in 1864, and many important memoirs by members of the teaching staff, and by students, have appeared in it. Pasteur was editor from 1864 to 1870, and was succeeded by Henri Deville, who held the position until 1881, though the publication must have entailed pecuniary loss. Finally, the *Annales* were placed upon a firm footing by M. Zevort, Director of Secondary Education, who twelve years ago increased the subscription list by providing for the introduction of the journal into a number of *lycées*, and since then the assistance thus rendered has been continued by succeeding Directors of Higher and Secondary Education. M. Debray held the editorship of the *Annales* from 1882 to 1888, and M. Hermite now edits it, with an editorial committee comprising many of the most eminent men of science in France.

Many other names, in addition to those already mentioned, have contributed to the glory of the school. The work of Galois, for instance, whose short life ended in 1832, while still a student at the school, has had great influence upon the development of mathematics.

In the early part of this century, little attention was paid to astronomy at the Normal School. The mathematicians there produced a number of important memoirs on celestial mechanics, and made astronomical tables, but practical astronomy was entirely neglected. When Le Verrier became director of the Paris Observatory, he obtained permission for a limited number of students to work at the Observatory while still retaining their position in the school. Victor Puiseux and Paul Desains were the two first students selected, and they were succeeded by Paul Serret and Marié-Davy. Le Verrier thus opened a new career for students at the school, and the way they availed themselves of it is shown by the fact, that, in 1866, there were as many as fifteen of them upon the Observatory staff. Among the names of astronomers who were students at the school, are MM. Tisserand, Rayet, André, Angot, Stephan, Simon, and Voigt; and at one time or another the school has provided directors for all the State observatories in France.

What more need be said? The names and works of the school's alumni are known and honoured throughout the scientific world, and that is sufficient testimony to the character of the instruction. The French Government is generous in its treatment of the school, but the expenditure is returned increased a hundredfold through the works of the students. And not only do these works benefit the Republic; they have an international value. Therefore the centenary which the school celebrated this year, interests all who are concerned with the advancement of natural knowledge.

R. A. GREGORY.

THE "GEMMI" DISASTER.

A MONTH ago, the Swiss newspapers were full of various accounts of a destructive avalanche which took place at the Gemmi on September 11, at 4 a.m. The first report read as follows: "A large part of the Altels glacier got loose and slipped down, covering three kilometres of ground on the Spital Alp, two hours' walk above Kandersteg. Men (6) and cattle (300) have been killed by the slipped mass. The break across the glacier may be seen from the valley with the naked eye. Help has been sent up from the villages of Leuk, Kandersteg, and Frutigen." (*Allg. Schw. Ztg.*, September 12.) More correct details afterwards decreased the loss of cattle by about one half, and the whole damage is estimated at from 60,000 to 80,000 francs.

The part concerned will be perfectly familiar to many English travellers. Few foot-tourists in Switzerland miss the Pass of the Gemmi, which bridges the beautiful limestone mountains between Canton Bern and Canton Wallis at their western end. The tourist coming from the North leaves the broad Aare Valley of Canton Bern and its lakes at Thun, and ascends gradually through the lateral Kander Valley towards the glaciated chain of the Diablerets, Oldenhorn, Wildstrübel and Altels on the southern horizon. The characteristic group of snowy summits known as the Blümlis Alp closes in the south-eastern. The valley itself is bestrewn with gigantic remnants of old mountain-slips, now clad with fir-tree and a rich flora. At Kandersteg it narrows, long moraines fringe the mountains, and the driving-road is left for a a steep winding footpath which climbs the mountain-sides beneath the shade of densely-grown larch and fir. The main stream hurls over rocky escarp and raves in deep ravine. A sudden opening in the wood discloses the tributary stream of the Gastern, its grey cliffs, and tumbling waterfalls; surely one of the most picturesque glens in the Alps!

Immediately beyond this point of view, the path descends slightly for a short distance and bends round the base of a wooded hill, known as the *Stierenbergli*, before it once more rises to the mountain pasturage and châlets of the *Spital*. Here, the sound of cow-bells rings over a grassy river-flat, hemmed in east and west by mountain ridges, northward by a thick tongue of moraine. Only one steep, narrow passage defiles the northern rocks and marks the contact of the Altels range with the moraine tongue. A dammed-up lake basin, often dry in summer, lies on the other side of the moraine where the road leads to the cosily-sheltered Schwarenbach Inn. Three-quarters of an hour's farther walk on rocky shelving